

NON-PUBLIC?: N
ACCESSION #: 8708180278
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Kewaunee Nuclear Power Plant PAGE: 1 of 4

DOCKET NUMBER: 05000305

TITLE: Electrical Bus Bar Failure Causes Undervoltage on RXCP Buses and
Reactor Trip

EVENT DATE: 07/10/87 LER #: 87-009-00 REPORT DATE: 08/10/87

OPERATING MODE: N POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR
SECTION

50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

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COMPONENT FAILURE DESCRIPTION:

CAUSE: C SYSTEM: EL COMPONENT: NSBU MANUFACTURER: CO48
REPORTABLE TO NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT: At 1143 CDT on July 10, 1987, with the plant at full power, a reactor/turbine trip occurred due to an undervoltage (UV) transient on the 4160 volt electrical buses, designated as 1-1 and 1-2, which supply the Reactor Coolant Pumps and Main Feedwater Pumps.

During normal power operation, the Main Auxiliary Transformer (MAT) powers the 4160 volt buses 1-1 and 1-2 from its "Y" windings and 4160 volt buses 1-3 and 1-4 was badly damaged due to insulation failure and a subsequent ground fault. The fault on the "X" windings caused the voltage on the "Y" windings to decrease resulting in a coincident undervoltage condition of less than 77% of rated voltage for greater than 0.1 seconds on buses 1-1 and 1-2, causing a reactor trip.

Immediately after the trip, operators implemented the appropriate Emergency Operating Procedures and stabilized the plant at Hot Shutdown. Plant systems performed as designed.

Prior to start-up, the damaged section of the Bus Bar was isolated. Buses 1-3 and 1-4 are currently being powered from the Reserve Auxiliary Transformer

(RAT), while the MAT continues to feed Buses 1-1 and 1-2. Additional corrective actions included contacting the manufacturer to provide an in-depth analysis and a consultant for an independent assessment. The damaged section of the Bus Bar will be replaced. There was no other equipment damage as a result of this event.

This event is being reported per 50.73(a)(2)(iv) as an actuation of the Reactor Protection System and actuation of Engineered Safety Features.

(End of Abstract)

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Description of Event

At 1143 CDT on July 10, 1987, with the plant at full power, a reactor/turbine trip occurred due to an undervoltage (UV) transient on the 4160 volt electrical buses (NSBU), designated as 1-1 and 1-2, which supply the Reactor Coolant Pumps (RXCP) (AB) and Main Feedwater Pumps (SJ).

At 1143, the Control Room operators received an unexpected Reactor/Turbine Trip. Following normal practice, an equipment operator was dispatched to verify that the Auxiliary Feedwater Pumps (BA) and Diesel Generators (EK) had started and were operating normally. On the 606' elevation of the Turbine Building the equipment operator noticed smoke and immediately notified the Shift Supervisor. The Shift Supervisor implemented Emergency Operating Procedure - "Fire". In accordance with that procedure he activated the plant's emergency siren which required all personnel on-site to assemble for accountability. Upon investigation, the equipment operator noticed smoke and fire coming from the vicinity of the electrical Bus Bar located on the eastern end of the 606' elevation of the Turbine Building. The bus fire terminated once the transformer was deenergized. A smaller fire was extinguished by the equipment operator when rags and rubber goods on a maintenance cart ignited by the falling aluminum slag. At 1146, the equipment operator reported to the Control Room that the fire had been extinguished.

During normal power operation the Main Auxiliary Transformer (MAT) (EL) fed by the Main Generator, powers the 4160 volt electrical buses 1-1 and 1-2 from its "Y" windings and 4160 volt electrical buses 1-3 and 1-4 from its "X" windings. Safeguards buses 1-5 and 1-6, although capable of being powered by the MAT, are normally supplied from offsite power via the Tertiary Auxiliary Transformer (TAT) and the Reserve Auxiliary Transformer (RAT) respectively. At the time of the event, the 4160 volt buses and supply transformers were in operation as designed and no system maintenance was being performed.

The event was caused by a phase to ground fault which occurred on the Bus Bar (1/2 by 4-inch flat aluminum bar rated at 3000 Amps, manufactured by Calvert Company (CO48)) routed from the Main Auxiliary Transformer to buses 1-3, 1-4, 1-5 and 1-6. The fault on the "X" windings caused the voltage in the "Y" windings to decrease. The decrease in the voltage of the "Y" windings caused an undervoltage condition on buses 1-1 and 1-2. The coincident undervoltage on both buses caused a Reactor Trip and subsequent Turbine Trip. The bus undervoltage reactor trip is set at less than 77% of the rated bus voltage for greater than 0.1 second.

The operators performed the recovery actions specified in Emergency Operating Procedure E-O, "Reactor Trip or Safety Injection", and proceeded to bring the reactor to the hot shutdown condition. A post trip review was performed to determine the trip initiating signal and safety significance.

Plant systems performed as designed. Buses 1-1, 1-2, 1-3 and 1-4 were automatically isolated from the Main Auxiliary Transformer and transferred to the Reserve Auxiliary Transformer. This fast transfer prevented the Reactor Coolant Pumps (RXCP) from tripping on the UV condition because of the time delay of approximately 5 seconds in the pumps breaker trip logic.

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The Bus Bar from the Main Auxiliary Transformer to Buses 1-3 and 1-4 was isolated and inspected for damage prior to start-up. At 1711, on the same day, operations commenced a plant start-up. At present, the Reserve Auxiliary Transformer feeds Buses 1-3, 1-4, and 1-6; the Main Auxiliary Transformer feeds Buses 1-1 and 1-2; and Tertiary Auxiliary Transformer feeds Bus 1-5.

Cause of Event

The root cause of the event was an insulation failure on the Bus Bar compounded by accumulation of particulate debris. The Bus Bar runs perpendicular to Turbine Building Ventilation Fans mounted in the Building exterior wall. The fan's suction pulled dust filled air through the section of the Bus Bar. Dust and metallic powder debris collected on the outside of the Bus Bar insulation. The insulation failure combined with the accumulated dirt provided a tracking path from phase to ground. The phase to ground fault progressed to a phase to phase fault which accounted for the extensive bus damage.

Analysis of Event

This event is being reported per 50.73(a)(2)(iv) as an actuation of the Reactor Protection System (RPS) and actuation of Engineered Safety Features (ESF) (JE).

The undervoltage signal on buses 1-1 and 1-2 is provided to trip the reactor to prevent the loss of forced circulation through the core under full power conditions via the Reactor Coolant Pumps. Undervoltage conditions from both electrical buses 1-1 and 1-2, which supply power to the pumps, initiates the reactor trip set at less than 77% of rated voltage for greater than 0.1 second. A time delay relay of approximately 5 seconds is designed in the RXCP logic to prevent tripping of the pumps before fast transfer to an off-site power supply. The Reactor Coolant Pumps did not trip and continued to supply forced circulation through the core.

In accordance with plant design, main feedwater was isolated after the reactor trip and the auxiliary feedwater system (BA) was automatically initiated to provide the necessary secondary heat removal. Both Diesel Generators 1A and 1B started as required on a turbine trip. There was no impact on the health or safety of the public.

Equipment damage was limited to a 30-foot section of the bus-bar from the MAT to buses 1-3, 1-4, 1-5 and 1-6. The related fire was quickly extinguished by the equipment operator. There was no other equipment damage as a result of this event.

During the activation of the plant emergency siren, plant personnel assembled and the plant fire brigade/team was dispatched. No plant personnel injuries were reported.

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Corrective Actions

The following corrective actions have been initiated:

A. Immediate Action

1. The damaged section of Bus Bar was isolated. The Bus Bar and Main Auxiliary Transformer were inspected to determine the extent of damage. A Temporary Change Request was implemented to supply electrical buses 1-3 and 1-4 from the Reserve Auxiliary Transformer and to continue supplying buses 1-1 and 1-2 from the Main Auxiliary Transformer. Safeguards buses 1-5 and 1-6 remained in their normal line-up.

B. Long Term Actions

1. The Bus Bar vendor and a consulting firm were contracted to provide an in-depth analysis of the insulation breakdown and recommend corrective actions.
2. A Design Change Request has been initiated to replace and repair the damaged section of the Bus Bar. Completion of repairs anticipated in late August.
3. Maintenance has begun inspecting and cleaning various sections of the Bus Bar ducting. They will implement a triennial inspection procedure covering all Bus Bar ducting.

Additional Information

Similar Events:

A similar event has occurred once before at Kewaunee. On January 5, 1980 a ground fault failure and subsequent Bus Bar connector failed on the "Y" windings of the Main Auxiliary Transformer due to water dripping on to the Bus Bar from a leak in the secondary analytical panel overhead. This caused a Reactor Trip, and related Turbine Trip. The damaged Bus Bar was replaced and the remaining Bus Bar was inspected.

Equipment Failure:

The Bus Duct was supplied as original equipment by the Calvert Company. The Bus Bar is 1/2 by 4-inch flat aluminum bar, full round edge, and rated at 3000 Amps. All three phases of the bus work is insulated with flame retardant insulation, and supported on molded flame retardant glass polyester supports. The bus work is enclosed in an aluminum ventilated housing.

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PUBLIC NRC-87-109

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U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Reportable Occurrence 87-009-00

In accordance with the requirements of 10 CFR 50.73, "Licensee Event Report System", the attached Licensee Event Report for reportable occurrence 87-009-00 is being submitted.

Very truly yours,

/s/ ILLEGIBLE
D. C. Hintz
Vice President - Nuclear Power

TJW/jal

Attach.

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